

Seroprevalence of BV (Macacine Herpesvirus 1) in Bred Cynomolgus Monkeys in Cambodia

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ABSTRACT. The seroprevalence of B Virus (BV, Macacine herpesvirus 1) in bred cynomolgus monkeys (*Macaca fascicularis*) in Cambodia was investigated. Blood samples were collected by venous puncture between 2007 and 2011, and a commercially available enzyme-linked immunosorbent assay (ELISA) kit was used to detect IgG antibodies against BV. A total of 1710 blood samples were examined, and the overall prevalence of BV antibodies was 33.92% (580/1710). The young adult (2–6 years) monkeys had a seroprevalence of 30.57% (497/1626), and the older (>7 years) monkeys had a seroprevalence of 98.81% (83/84). The present investigation revealed that the prevalence of BV antibodies in bred cynomolgus monkeys was highly correlated with their age, with higher prevalence in older monkeys in Cambodia.

KEY WORDS: BV (Macacine herpesvirus 1), Cambodia, cynomolgus monkey, *Macaca fascicularis*, seroprevalence.

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Cynomolgus monkeys (*Macaca fascicularis*) are an important non-human primate model for a variety of biomedical research areas. Monkey B Virus (BV, Macacine herpesvirus 1) is a macaque α -herpesvirus that is closely related to the human herpes simplex viruses (HSV) [2, 4]. BV can rapidly invade the central nervous system (CNS) when it is transmitted to other species such as humans, resulting in an ascending encephalomyelitis that has a fatality rate of more than 70% if not treated promptly [4, 8].

Thousands of cynomolgus monkeys bred and raised in Cambodia have been exported to North America, Europe and other Asian countries for biomedical research. However, little is known of BV infection in bred cynomolgus monkeys in Cambodia. Therefore, the objective of the present survey was to investigate the seroprevalence of BV infection in bred cynomolgus monkeys in Cambodia.

Serum samples were collected by venous puncture from cynomolgus monkeys just prior to export from non-human primate centers in Cambodia between 2007 and 2011. All the cynomolgus monkeys were caged and treated in strict accordance with good animal practice as defined by the relevant national and/or local animal welfare bodies, and all animal work was approved by the appropriate committees.

Because the monkeys' birth dates were not officially recorded, their precise ages were not known. Dentition and tooth wear were used to estimate the ages of monkeys at the time of blood sampling, but this is not a very accurate

method, so we could only determine that the monkeys were 2–6 years old or more than 7 years old.

A total of 1710 serum samples were tested for BV IgG antibodies using a commercially available enzyme-linked immunosorbent assay (ELISA) kit (Haitai Co., Ltd., China). Positive and negative controls were included in each test. Those samples with uncertain or positive results were re-tested.

Differences in seroprevalence of BV in bred cynomolgus monkeys between the two age groups were analyzed using the Chi square test in SPSS for Windows (Release 13.0 standard version, SPSS Inc.). The differences were considered to be statistically significant when $P < 0.05$.

The total prevalence of BV antibodies in bred cynomolgus monkeys in Cambodia was 33.92% (580/1710). The young adult (2–6 years) monkeys had a prevalence of 30.57% (497/1626), and the older adult (>7 years) monkeys had a prevalence of 98.81% (83/84) (Table 1).

BV infection rarely results in clinical symptoms and severe disease in its natural host; instead, the virus establishes latency in sensory neurons, and latent virus can later reactivate and be shed in oral or genital secretions [8]. The seroprevalence of BV infection in bred cynomolgus monkeys in Cambodia was comparable to those reported in some regions [1, 3, 5–7], however, it was higher than that in performance monkeys (*M. fascicularis*) in Jakarta, Indonesia [7] and Taiwan [5] which had a prevalence of 5.3% and 11%, respectively, but lower than those reported in Brazil (71% [1]), Japan (60%, [6]) and Indonesia (81.6%, [3]). The difference in BV prevalence in different regions may be due to differences in ecological and geographical conditions, climate, as well as the conditions for monkey breeding.

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Table 1. Seroprevalence of BV infection in bred cynomolgus monkeys in Cambodia determined by ELISA

Age, y	Male		Female		Total	
	No. positive/ no. examined	Prevalence, %	No. positive/ no. examined	Prevalence, %	No. positive/ no. examined	Prevalence, %
2–6	182/496	36.69	315/1130	27.89	497/1626	30.57
>7	38/38	100	45/46	97.83	83/84	98.81
Total	220/534	41.2	360/1176	30.61	580/1710	33.92

The BV prevalence in bred cynomolgus monkeys increased with age, and there was a very significant difference ($P < 0.01$) in the seroprevalence of BV infection between monkeys of 2–6 years old and those > 7 years old (Table 1), which was in accordance with previous reports [1, 3, 6]. The likelihood of fighting, biting and coitus increases with age, and BV shed in oral or genital secretions can infect other monkeys during these activities.

It is recommended that workers or researchers wear uniforms, gloves, hats and masks to avoid contact with secretions of monkeys infected with BV, and also to prevent monkeys from biting. To reduce transmission of BV, BV antibodies should be monitored regularly, and seronegative and seropositive monkeys should be bred and raised in different buildings. BV testing should be done on all imported monkeys. To our knowledge, this is the first report of BV infection in bred cynomolgus monkeys in Cambodia. A survey of BV infection in wild cynomolgus monkeys is warranted.

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